Does private health insurance coverage allow higher consumption level? - Evidence based on three database

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Abstract

How do older people determine their consumption level, and how does private health insurance coverage influence this decision? What is the reason for the empirical finding that those who are covered with private health insurance seem to realize higher consumption expenditures? Is this an evidence for precautionary saving motives? This paper provides some answers to these questions.

The paper consists of two parts: in the first part, I present a life-cycle model for consumption level when lifetime and medical expenditures are uncertain. In the second part, I estimate the effect of health insurance on consumption level. This analysis is done in an international perspective, using three comparable datasets.

Keywords: consumption function, ageing, life expectancy, private health insurance
JEL classification: D81, D91, J14

1 Introduction

Based on two European and an American database of elderly people, those who have some type of private health insurance seem to afford themselves a higher level of consumption, even when their income and wealth levels are similar to the uninsured. My aim in this study is to give an explanation for this finding, assuming rational decision making, and to make the first steps towards the analysis of institutional (and possibly cultural) effects through international comparisons. Multi-country data makes it also possible to enhance the robustness of the empirical results.

The effect of health insurance on consumption can be exposed with allowing uncertainty of medical expenditures in a life-cycle model. I additionally extend the basic life-cycle model with lifetime uncertainty. This extension is reasonable since the model and the empirical analysis applies to elderly people. Assuming certain income and no bequest motives, their rate of wealth decumulation (consumption level) is influenced by how long they expect to live. Higher life expectancy means that the wealth holding should finance consumption over a longer time period. This effect can be blurred if they have to set aside money for possible future medical costs. This implies an extension towards the precautionary savings literature. Following Kimball (1990), the theory of precautionary savings states that if households are prudent (i.e. the 3rd derivative of the utility function is positive), then lower risk of future income or expenditure decreases saving and increases consumption. Health insurance can decrease the uncertainty about future out-of-pocket medical expenses, hence it can crowd out precautionary savings.

In this paper first I derive a model for consumption level with uncertain lifetime, that sheds light on the potential positive effect of private health insurance coverage on consumption level. Using restrictive, but not unrealistic assumptions it is possible to derive a closed form solution for consumption level. The modelling framework is related to the life-cycle models with mortality risk, which are based on the seminal article of Yaari (1965). He derives optimal consumption and saving dynamics under uncertain lifetime, with and without bequest motive and life insurance. On the other hand, Hamermesh (1985) used survey data first to investigate the determinants of subjective survival probabilities, and pointed to its potential importance in analyzing life-cycle behaviors. Closely related models to the one presented here are developed by Hurd (1989), Gan et al. (2004) and Salm (2006), who estimate life-cycle models with mortality risk and bequest motive. Salm (2006) also considers the effect of uncertain medical expenditures on consumption dynamics. Jurges (2006) poses a similar question, he analyzes the effect of health on saving intentions, based on the SHARE (Survey of Health, Ageing and Retirement in Europe) data. One contribution of my analysis is the aim to explain the consumption level at a given time point. The general approach instead in the literature is to develop a consumption path, and estimate the Euler equation.

The effect of health insurance coverage on saving decisions is an unsettled question in the relevant literature. Despite the theoretical implications, there is no clear empirical evidence for the existence of precautionary saving motives, and in particular for the negative effect of health insurance coverage on savings, as summarized e.g. by Chou et al. (2003). Moreover, most studies have to face the problem of potential selection bias, as insurance coverage is generally not exogenous. For example, based on the Survey of Consumer Finances (U.S.), Starr-McCluer (1996) finds that households covered with private health insurance have higher wealth levels than the uncovered ones, ceteris paribus. She estimates a joint model for insurance coverage and wealth holdings. On the other hand, Palumbo (1999) claims using PSID (Panel Study of Income Dynamics, U.S.) data that uncertainty of medical expenses induces precautionary savings. He finds that the predicted consumption level decreases towards observed values if the life-cycle model is extended with uncertain medical expenses. Hubbard et al. (2005) also use PSID data, and find that for low-income households an asset-based, means-tested social insurance program discourages saving. They explain it by a life-cycle model. Chou et al. (2003) use micro data from Taiwan to show the negative effect of health insurance coverage on savings, based on a natural experiment. These studies are about the effects of being covered by any (possibly state provided) health insurance at all, whereas in case of Europe the effects of complementary or supplementary health insurance are of more interest. As regards Europe, the effect of private health insurance on savings is an under-researched area.

The second part (sections 3 and 4) of my study can contribute to this literature, using three comparable database with multi-country coverage. I analyze the effect of private health insurance coverage on consumption level in details, including cross-country comparisons. A positive effect of voluntary health insurance on consumption level can be seen as an evidence for its welfare improving effect, therefore I also point to some possible welfare and policy implications.

2 Extended life-cycle model

The influencing effect of health insurance coverage on consumption level can be explained with an extended life-cycle model. An alternative approach could be that people follow a buffer-stock saving behavior. This would imply that individuals maintain a certain amount of wealth holdings against future income or expenditure shocks. Since my model relates to elderly people, who generally have stable income and decide on the wealth decumulation rate, assuming buffer-stock saving is not appropriate here. Hubbard et al. (2005) and Salm (2006) also use similar argumentation for applying life-cycle models.

Two mechanisms could drive the effect of health insurance coverage on consumption. First, if having voluntary health insurance decreased the realized medical expenditure, then it would have the same effect as having higher income. However, based on European data the average annual payment on health insurance contracts (for those who have such contract) is higher than the average annual out-of-pocket medical expenditure of the elderly individuals without voluntary health insurance.[1] Hence, this income effect does not seem plausible. The second mechanism - which is extensively discussed in the precautionary savings literature - works through the decreasing effect of insurance coverage on the variance of medical expenses. These expenses can be regarded as shocks to the consumption, and e.g. Browning - Lusardi (1996) and Salm (2006) derive Euler equations showing that higher consumption shock variance has a positive effect on consumption growth. My focus here is however on the consumption level. Browning - Lusardi (1996) also suggest that health insurance coverage can be treated as an exogenous source of risk that varies across the population, when analyzing precautionary motives.

In two related models, Deaton (1992) and Chou et al. (2003) derive based on constant absolute risk aversion (CARA) utility function that increased uncertainty of income or consumption has negative effect

[1] This is even true when self-reported health status is controlled for. The database is presented in Section 3. Some more details about out-of-pocket medical expenditure are provided in Section 4.2.2.

on the consumption level. A similar result will be derived here using constant relative risk aversion (CRRA) utility function, and allowing for lifetime uncertainty.[2] The novelty of my model is to arrive at a closed-form solution for consumption level. This aim necessarily requires a series of assumptions and simplifications.

A general life-cycle model with liquidity constraint, mortality risk, uncertain medical expenditures and bequest motive has no closed-form solution for consumption level. Therefore, the most often followed approach in the relevant empirical literature is to estimate some form of the Euler equation (consumption dynamics), instead of the consumption level. For example, Zeldes (1989) splits his sample into two parts based on whether the liquidity constraint is binding, and estimates the Euler equation separately for the two subgroups. His distinction of the two groups is based on the wealth to income ratio, using PSID data. Salm (2006) also estimates an Euler equation (for annual consumption change) with excluding the credit constrained agents. His exclusion is based on the answer to the question in the HRS (Health and Retirement Study, U.S.) on spending a possible windfall gain. On the other hand, Gan et al. (2004) develop a numerical algorithm for estimating a model similar to the one presented here.

Considering that my focus here is on the effect of health insurance coverage on consumption level, and that my empirical analysis covers panel data with only one or two waves, a numerical estimation method similar to the procedure of Gan et al. (2004) does not seem appropriate here. I follow the alternative approach: to analyze the determinants of consumption level only of those individuals for whom the credit constraint is not binding. This approach is similar to the strategy of Zeldes (1989) and Salm (2006) of separating those individuals in the modelling and estimation for whom the credit constraint is binding. If the credit constraint is binding (zero wealth level), the consumption is expected to closely follow the income process, although the uncertain future medical expenses might induce some savings from current income even at older ages. As I am basically interested in the determinants of wealth decumulation, I analyze here the consumption decisions only of individuals with positive wealth.

The model fits into the widely used life-cycle framework, the basic setup follows Gan et al. (2004) and Engen et al. (1999) - however, the latter authors assume that there is no bequest motive but allow for income uncertainty in their model. I write up the model in discrete time, which makes the numerical analysis and the interpretation of the variables easier. Index i refers to the ith individual, whereas the second index t refers to the tth time period ($t = 1...T_i$, where T_i is the maximum remaining years of life). The model applies to retired individuals, who have a constant level of income (Y_i, typically pension income or social security benefit), apart from the return on their wealth. Moreover, it describes the behavior only of those who have non-negative wealth. The decision variable of the individual is the level of consumption ($C_{it}, t = 1...T_i$). The consumption, the initial wealth level and the exogenously given medical expenses ($M_{it}, t = 1...T_i$) determine the wealth path ($W_{it}, t = 1...T_i$). M_{it} also includes all the costs (contributions) related to the private health insurance, and I assume that insurance coverage is pre-determined.[3] The individual chooses a consumption path that maximizes the present value of the expected utility from consumption, I do not consider the decision about insurance coverage. Consumption happens at the beginning of each period, whereas income and medical expenses are due at the end of each period. There is no explicit utility from bequest, nevertheless, to maintain the possibility for bequest motive, I will assume that the individuals plan to leave a certain amount ($B_i \geq 0$) of wealth as bequests. This simple treatment of bequest motives is satisfactory here, since my aim is to reveal the main influencing mechanism, and I do not estimate the parameters of the utility function.[4] This assumption implies a "target saving" behavior (as described e.g. by Elmendorf (1996)).

The individuals maximize the expected discounted present value of future consumption, subject to the credit constraint. Hence, the optimization problem of individual i is:

[2] The choice between constant relative vs. absolute risk aversion utility functions is based on technical reasons. Assuming CRRA utility makes the derivations tractable.

[3] Based on the HRS data, for ca. 80% of individuals aged at least 70 the insurance coverage status did not change between two consecutive survey waves. It indicates that this assumption is not too restrictive.

[4] Assuming a targeted bequest value makes it possible to write up a lifetime budget balance condition, as shown in the Appendix. The more standard approach is to include a utility from bequest in the lifetime utility.

$$
\begin{aligned}
&\max_{\{C_{it},t=1\ldots T_i\}} \sum_{t=1}^{T_i} s_{i1}^t (1+\rho)^{1-t} E_1\left(U(C_{it})\right) \\
&\text{s.t. } W_{it} = (1+r)(W_{it-1} - C_{it}) + Y_i - M_{it} \\
&\qquad W_{it-1} \geq C_{it}, \forall t = 1 \ldots T_i,
\end{aligned} \tag{1}
$$

where s_{ij}^k is the subjective probability of individual i at time j of being alive at time k, ρ is the discount rate, and r is the interest rate. $U(C_{it})$ is the utility function, assumed to be concave and increasing in C_{it}, and E_t is the expectations operator at the beginning of period t. Since the survival probability is interpreted on the individual level, this model applies to individuals, and not to households. Moreover, I assume that the utility of current consumption is of the constant relative risk aversion (CRRA) form: $U(C_{it}) = \frac{C_{it}^{1-\gamma}}{1-\gamma}$. Here γ is the coefficient of relative risk aversion, and its reciprocal $\varphi(=\frac{1}{\gamma})$ is the intertemporal elasticity of substitution.

From this setup, the following Euler equation can be derived for the consumption dynamics:

$$
\frac{s_{it}^{t+1}(1+r)}{1+\rho} E_t\left[\left(\frac{C_{it+1}}{C_{it}}\right)^{-\gamma}\right] = 1. \tag{2}
$$

This equation holds only if the credit constraint is not binding, i.e. if the value of net wealth is positive or if the current income minus medical expenditure exceeds the consumption expenditure. I provide some more details about this restriction in Section 3. The derivations can be found in the Appendix. With concave utility function ($\gamma > 0$), equation (2) shows that higher probability of survival to the next period ceteris paribus increases the consumption in the next period relative to the current period.

In order to arrive at an expression for the consumption level, based on the Euler equation, some approximations are need to be used. I apply the method of second-order approximation, as described in details by Carroll (2001).[5] This procedure gives that:

$$
C_{it+1} = C_{i1}\left[\frac{s_{i1}^{t+1}(1+r)^t}{(1+\rho)^t}\right]^{\varphi} V_i^{t\frac{\gamma+1}{2}}. \tag{3}
$$

V_i is a measure for uncertainty of consumption, due to uncertain medical expenditures. Again, the derivations are presented in the Appendix. To arrive at the final solution, and allowing some form of bequests in the model, a further assumption is needed. For the sake of simplicity, I assume that the expected present value of bequest equals its targeted value B_i, if the consumption path follows the path determined under (3). The general approach in consumption models is to either disregard the bequests, or to take into account account bequest motives, by assuming that bequeathing increases the utility. Since my model refers to older individuals, neglecting bequests would be unreasonable. Nevertheless, in this study I do not focus on bequest motives, and I do not apply structural estimation methods here, therefore a simple approach is appropriate. Assuming a pre-determined target bequest value can be interpreted as bequeathing individuals adhere to social norms, or leave their immovable estates as bequest. Furthermore, a closed-form solution for consumption level is available only for those individuals for whom the credit constraint never becomes binding. Thus, this solution is likely to be valid only if W_{i0} is relatively large. This leads to the following expression for consumption:

$$
C_{i1} = \frac{W_{i0} - B_i + Y_i \sum_{j=1}^{T_i} s_{i1}^j \frac{1}{(1+r)^j} - \sum_{j=1}^{T_i} \frac{E_1(M_{ij})}{(1+r)^j}}{\sum_{j=1}^{T_i} s_{i1}^j \frac{1}{(1+r)^{j-1}} \cdot \left[\frac{s_{i1}^j (1+r)^{j-1}}{(1+\rho)^{j-1}}\right]^{\varphi} V_i^{(j-1)\frac{\gamma+1}{2}}}. \tag{4}
$$

This expression clearly shows that the life-cycle model with CRRA preference and uncertain medical expenses imply precautionary saving - other things being equal, increasing uncertainty (higher V_i) decreases the optimal level of consumption, provided that the utility function is concave ($\gamma > 0$). Even in this simplified

[5] Carroll (2001) does not support using the second order approximation, because in his framework it is hard to identify suitable instruments for the variability term.

setup, the partial effect of life expectancy on consumption level is ambiguous. On the one hand, an upward shift in the subjective survival curve has a negative effect on consumption since the current wealth holdings can be decumulated at a slower rate so as not to deplete them. On the other hand, it increases the present value of expected future income, which can have an increasing effect on consumption. Taking into account the effect of life expectancy on consumption preferences would further weaken these results.

3 Data description

In the empirical analysis I use three comparable datasets, the HRS, ELSA, and SHARE. These are called "sister studies", since their structure and coverage are similar. All three surveys cover individuals aged 50 or over, and their spouses. The sample sizes are around 20-30 thousand. These are (or will be, in case of the SHARE) panel surveys, and the waves follow each other generally every second year. The questionnaires include detailed questions about demographics, health, income, employment, wealth, and expectations. The first database I use here is the RAND HRS, which is a cleaned and user friendly subset of the Health and Retirement Survey, created by the RAND Center for the Study of Aging.[6] The HRS is a U.S. survey, and has already eight waves, covering years 1992 to 2006. The English Longitudinal Study of Ageing (ELSA) is also a biannual survey, covering years 2002-2007 (three waves).[7] The third database that I use in the empirical analysis is the first wave (year 2004 observations) of the Survey of Health, Ageing and Retirement in Europe (SHARE), release 2.0.1.[8] It is also intended to be a panel database (the second wave is going to be released in November 2008), covering individuals aged 50 or over, and their spouses. The database covers over 30 thousand individuals from twelve countries.

The similar structure of the three surveys makes it possible to repeat almost the same estimations on each. The observation period can also be limited to be overlapping: year 2004 observations match the 1st wave of SHARE, 2nd wave of ELSA, and the 7th wave of the HRS. Despite the similarity of the three database, some variables of interest, like the consumption measure and the voluntary health insurance indicators cannot be specified in the same way. I discuss these differences in the next paragraphs.

I limit the analysis here to single individuals, aged at least 70. The first restriction eliminates the problem of observing some variables only on the household level (e.g. reliable income and wealth measures), others only on the individual level (e.g. the subjective survival probability). The reason for age restriction is that constant (annuity) income can be assumed only for the oldest, and asset decumulation refers in general only to the retired people. The share of retirees who are not working any more is sufficiently high above age 70. Moreover, within the oldest age group the homogeneity of preferences can be an acceptable restriction.

For the consumption, income and wealth level, I use imputed values. The missing values are imputed five times in the SHARE database, and using only one or the average of these five imputations would result in biased estimates (underestimated standard errors). On the other hand, ELSA and RAND HRS have only single imputations. Based on the results of Rubin (1987), the multiple-imputation point estimates of regression parameters, associated variance estimates and confidence intervals can be derived. In the OLS estimation procedures for the SHARE database I use the Stata package developed by Carlin et al. (2003) for manipulating and analyzing multiple datasets.

[6] The HRS (Health and Retirement Study) is sponsored by the National Institute of Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan.

[7] The data were made available through the UK Data Archive (UKDA). ELSA was developed by a team of researchers based at the National Centre for Social Research, University College London and the Institute for Fiscal Studies. The data were collected by the National Centre for Social Research. The funding is provided by the National Institute of Aging in the United States, and a consortium of UK government departments co-ordinated by the Office for National Statistics. The developers and funders of ELSA and the Archive do not bear any responsibility for the analyses or interpretations presented here.

[8] The SHARE data collection has been primarily funded by the European Commission through the 5th framework programme (project QLK6-CT-2001- 00360 in the thematic programme Quality of Life). Additional funding came from the U.S. National Institute on Ageing (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, Y1-AG-4553-01 and OGHA 04-064). Data collection for wave 1 was nationally funded in Austria (through the Austrian Science Foundation, FWF), Belgium (through the Belgian Science Policy Office), France (through CNAM, CNAV, COR, Drees, Dares, Caisse des Dépôts et Consignations et le Commissariat Général du Plan) and Switzerland (through BBW/OFES/UFES. The SHARE data collection in Israel was funded by the U.S. National Institute on Aging (R21 AG025169), by the German-Israeli Foundation for Scientific Research and Development (G.I.F.), and by the National Insurance Institute of Israel. Further support by the European Commission through the 6th framework program (projects SHARE-I3, RII-CT- 2006-062193, and COMPARE, CIT5-CT-2005-028857) is gratefully acknowledged. For methodological details see Borsch-Supan - Jurges (2005).

In the empirical analysis I use the following variables:

- Consumption: The dependent variable in my model is the consumption level. Unfortunately, it cannot be defined analogously in the three database. As for the SHARE database, the proxy for consumption level is the sum of the imputed ppp-adjusted yearly expenditure on food at home and outside the home. This means that due to data limitations, and the availability of only one wave of data, at this stage only the food consumption can be modelled. This consumption category is narrow, however, it has the advantage that it can be measured relatively precisely, and does not include expenditure on durables, that could bias the results. The expenditure measure is purchasing power parity adjusted.

  Since there is no data on the consumption (or food consumption) expenditure in the ELSA and HRS data, I can use the total household income minus the annualized change in financial wealth since the last (on average two years earlier) wave. Since nominal values are used, I assume 4% yearly yield on financial assets, to calculate the 2004 value of lagged wealth holdings. I should take the medical expenses out from the consumption measure based on the assumption that these are not the results of wealth decumulation decisions, but are instead "obligate" costs. However, such data is not available in the ELSA database, therefore I decided also not to exclude them when using the HRS, for the sake of comparability. I apply financial wealth as the wealth category, because the changes in its value is likely to reflect the most the consumption decisions. For example, it excludes housing wealth, which because of its low liquidity can have only little influence on the consumption level (this might be true especially for the older people, unless they take reverse mortgages), and its value can strongly be influenced by market fluctuations. [9] In addition, this wealth category also excludes the value of private retirement accounts, since the total household income measure captures the changes in that. However, as Perry (2006) and Hudomiet (2008) also discuss in details, a proxy for consumption level generated such a way is subject to measurement error. This follows not only from the possibly biased survey responses, but also from the missing values of some wealth components, where these values are substituted with imputations in the RAND HRS or ELSA database. Furthermore, such a wealth measure includes also the effect of the rate of return on assets. Nevertheless, this causes only minor problems if there is no systematic variation in the rate of return across households.

  A clear indicator for the measurement error is the relatively large share of negative consumption measures among the overall observations of single individuals aged 70 and above. Negative values are excluded from the empirical analysis, for the HRS data this means that ca. 14% of the otherwise applicable wave 7 data has to be excluded. For the ELSA data this ratio is better, it is around 9%. Using nominal values can cause some data problems, but it cannot explain such a relatively large ratio of negative generated values. Large outlier consumption observations are also excluded: this limit is $1M for the HRS, and £100Th for the ELSA (around ten observations are dropped with these limitations in each database). Summary statistics of consumption, and of the other financial variables can be seen in Table 1. The statistics refer to only those observations that can be included in the estimations - i. e. the consumption expenditure is positive, the credit constraint is not binding, and the subjective survival probability is not missing (these restrictions are described in the following paragraphs). The standard deviation of this measure is relatively larger when it is generated from the income and wealth.

- Voluntary health insurance coverage: This is a dummy variable, which equals one if the individual is covered with any type of voluntary, supplementary or private health insurance, and is zero otherwise. In the SHARE questionnaire it is specified that these types of insurance supplement the coverage available from the state. Although there is almost universal coverage with state provided health insurance in Europe, Figure 1 shows that the cross country differences in voluntary health insurance coverage are large. Similarly to Europe, the coverage with government health insurance program in the U.S. is also almost universal in the restricted sample (year 2004, single people aged 70+). According to the HRS data, 98% of the respective individuals were covered with such program (mainly Medicare). In

[9] Contrary to this assumption, Case et al. (2001) find that housing wealth has larger effect on consumption than stock market wealth, based on U.S. and international aggregate data. Nevertheless, this can be explained by the sophisticated financial instruments that are less likely to be used by the oldest people.

	SHARE (€Th)	HRS ($Th), wave 7	ELSA (£Th), wave 2
Consumption (yearly)	3.87	46.37	12.24
	(3.28)	(83.21)	(12.50)
Net financial wealth	36.33	66.41	17.77
	(165.42)	(184.47)	(35.21)
Income (yearly)	22.92	24.78	9.01
	(28.39)	(35.66)	(6.14)
Medical expenditures (yearly)	0.67		
	(1.40)		
Survival probability (0-1 scale)	0.42	0.37	0.41
	(0.31)	(0.32)	(0.32)
Inheritance probability (0-1 scale)	0.60	0.63	0.62
	(0.41)	(0.41)	(0.39)
# obs.	2,051	1,228	961

Table 1: Mean value of the key variables (standard deviation in parenthesis), based on the restricted SHARE, HRS, and ELSA samples. Definitions of variables are provided in the text.

the U.K., the National Health Service also provides a universal coverage of all citizens. Despite the state provided insurance, coverage with voluntary health insurance is still not negligible in most of the countries, since that can help finance co-payments, or can ensure better quality or faster treatment.

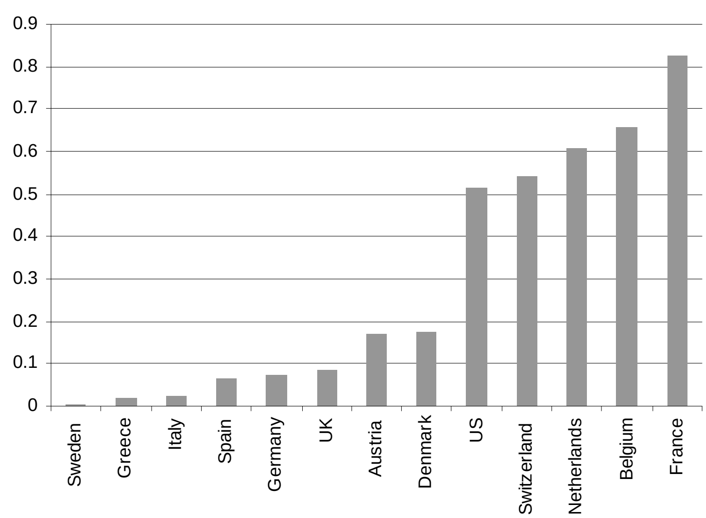

Figure 1: Ratio of individuals covered by voluntary health insurance (singles, aged at least 70), ELSA, HRS, and SHARE data

In the ELSA database there is only one indicator for being covered by private health insurance (either in own name or through another family member) - in the restricted sample 8.5% of the older individuals were covered with such insurance in the U.K. For the HRS data, I set the voluntary insurance dummy to one if the individual is covered by health insurance from current or previous employer[10], or by long-term care insurance[11], or by other private health insurance. Based on this indicator, 51.3% of the examined people were covered with such non-governmental insurance in the U.S. In addition, it can be seen that this indicator is quite persistent on the individual level. For example, from wave 6 to

[10] In the U.S., retired elderly can receive health insurance from a former emplyer.

[11] Such insurance can cover nursing home care, in home care or both.

wave 7 (from year 2002 to 2004), for ca. 78% of the relevant sample the private insurance status did not change (12% became uncovered and 10% became covered). In the UK, the percentage of those for whom the private insurance status changed between the first and second wave of ELSA is even lower, around 5.5%.

	SHARE, wave 1	HRS, wave 7	ELSA, wave 2
Female	$+^{***}$	-	$+^{***}$
Age	$-^{**}$	-	+
log(Financial wealth)	+	$+^{***}$	$+^{***}$
log(Income)	+	$+^{***}$	$+^{***}$
Education level	$+^{***}$	$+^{***}$	$+^{**}$
Number of children	-	$-^{***}$	-
Self-reported health (1-5 scale: 1-excellent, 5-poor)	-	-	$-^{**}$
Ever smoked	$+^{*}$	$-^{**}$	-

Table 2: Probit estimation results (sign and significance level), dependent variable: voluntary health insurance coverage. Country dummies not reported. *,**,***: significant at 10, 5, 1 % significance levels respectively

Even though the figures presented here are restricted to single individuals aged at least 70, the pattern of variation in coverage in the European countries is in line with the findings of Mossialos - Thomson (2004). The uneven coverage across the countries can be basically traced back to institutional differences. The reason for the high rate of coverage in France is that the reimbursement of co-payments for treatment in the statutory health care system is possible through voluntary health insurance. In the Netherlands and Belgium the self-employed and the high earners are likely to purchase voluntary insurance as a substitute for the insurance available from the state. The low coverage in some other countries can be explained by the generosity of state benefits (e.g. Sweden and Denmark) or by cultural reasons (Greece, Italy and Spain). [12] By probit estimation (including country dummies in case of SHARE) it can be seen that on average the younger individuals, females and those with higher education are more likely to have some kind of voluntary health insurance, whereas income and wealth has no significant effect. These results are illustrated in Table 2. Paccagnella et al. (2005) finds no such variable based on SHARE data that would be significant in determining the coverage for all countries, which also shows the different role of voluntary private health insurance across the countries. On the other hand, both in the U.K. and U.S. wealth and income has positive partial effect on the probability of being covered by voluntary health insurance.

Table 3 shows a more detailed statistics of voluntary health insurance coverage. Such detailed data is available only for the countries covered by the SHARE. There is a large variation with respect to the importance of the various insurance types. It is remarkable for example, that in the Netherlands only the dental care and drug expenses are insured, whereas in France almost all insurance types have a large coverage. In case of Belgium, the other services that are widely insured are the costs of transport by ambulance and the extra costs of having an individual room in hospital. Because of this variability of insurance types, I will restrict the insurance coverage indicator to more homogenous categories in Section 4.2.2.

- Life expectancy: I use the self reported probability of living ca. 10 more years as the indicator of subjective life expectancy. The phrasing of this question is similar in all three database, "what are the chances that you will live to be (80, 85, 90, 95, or 100) or more", where the target age depends on the age of the respondent. I scale this variable to lie between 0 and 1. Theoretically, longer life expectancy should decrease the consumption level (decrease wealth decumulation), but this can be mitigated by the income effect, risk aversion, or changing preferences - as discussed in Section 2. It would be desirable

[12] A more detailed analysis of cross-country differences can be found in Mossialos - Thomson (2004), and also in Paccagnella et al. (2005).

	Swe	Gre	It	Sp	Ge	Au	Dk	Swi	Nl	Be	Fra
Medical care with direct access to specialists		1.5	0.5	6.1	2.9	1.0	6.2	9.5		7.8	61.0
Medical care with an extended choice of doctors		0.6		2.9	2.5	1.0	5.2	7.8		0.2	38.7
Dental care		0.6		1.8	3.3	0.3	9.5	0.9	34.0	2.7	63.2
A larger choice of drugs and/or full drugs expenses		0.9	0.5	1.1	0.4	0.3	8.1	9.5	34.0	1.5	60.3
An extended choice of hospitals and clinics for hosp. care		0.6	0.9	2.9	3.3	11.6	1.9	15.5		0.5	63.8
Long term care in a nursing home				0.4		0.3	0.5	2.6		0.7	53.7
Nursing care at home in case of chronic disease or disability		0.3		1.8		0.3		7.8		0.2	42.9
Home help for activities of daily living		0.3		0.7		0.3		7.8		2.4	20.3
Full coverage of costs for doctor visits		0.9		2.9		1.0	2.8			2.4	45.7
Full coverage of costs for hosp. care	0.3	0.9		1.8	3.7	5.8	2.8	2.6		36.7	11.8
Other										63.8	

Table 3: Percentage of individuals covered by specific types of voluntary health insurance (single individuals, aged at least 70), SHARE data

to use lagged expectations as influencing factors of consumption, however with only one wave of data that is not possible.[13]

In this paper I do not correct for the data problems of subjective survival probability, because of the complexity of this issue. The first problem is the non-response. In all three datasets the non-response rate is relatively high in the 2004 data, among single individuals aged at least 70. This rate of non-response is 6% in the ELSA, 32% in the HRS, and 68% in the SHARE.[14] OLS and probit estimates indicate that younger, healthier and more educated people are more likely to answer the survival probability question. The second problem is the large ratio of so-called focal responses, especially of 0, 10, 50, and 100% answers. Hill et al. (2004) argue that focal responses are the consequences of uncertainty of the personal longevity, and apply the "modal response hypothesis" to uncover the mechanism of answering such survey questions. Gan et al. (2003) also address the focal response problem by applying a Bayesian update model.

On the other hand, following Hamermesh (1985) and Hurd - McGarry (1993) there is some evidence that on average, subjective survival probabilities are consistent with life tables and they covary with such observable characteristics that are likely to affect longevity. Based on the Survey of Economic Expectations, Dominitz - Manski (1997) also argue that eliciting probabilistic expectations in household surveys is feasible, despite that it is not evident that respondents think probabilistically about uncertain events. These considerations provide some reason for using the survival probability answers, and supposing that these subjective expectations have some behavioral effects. This remark is also supported by OLS estimations, where the answer to the survival probability question (in percentage) is regressed on some observables, as reported in Table 4: parents' age has positive but weak effect, while health problems have negative effect on the survival probability, ceteris paribus.[15] As an interesting result, income seems to have negative effect on the reported survival probability.

- Wealth: The imputed value of net financial assets is used, in case of SHARE data this is ppp-adjusted, for the sake of comparability. There is no consensus in the literature, how wealth should be defined

[13] To enhance comparability, I use the current expectations also in case of ELSA and HRS data.

[14] The response-rate is very low, below 20% in Italy and Spain.

[15] I have repeated the estimations with Heckman selection model for the HRS data, in order to correct for the selection bias in answering the survival probability question. It did not qualitatively change the results for the determinants of survival probabilities, although the p-values generally became higher.

	SHARE, wave 1	HRS, wave 7	ELSA, wave 2
Age	-1.309***	-1.759***	-0.623**
Father‘s age or age at death	0.041	0.028	-0.090
Mother‘s age or age at death	0.042	0.083**	0.233**
Self-reported health (1-5 scale: 1-excellent, 5-poor)	-5.718***	-7.828***	-7.462***
Total income ($Th-HRS, £Th-ELSA, ppp-adjusted €Th-SHARE)	-0.031*	-0.011**	-0.474
const.	159.788***	193.614***	107.472***

Table 4: OLS estimation results, dependent variable: subjective probability of living ca. 10 more years (in %); *,**,***: significant at 10, 5, 1 % significance levels respectively, based on robust standard errors

in consumption and saving models. The reason for choosing this limited wealth category is that these assets are liquid enough to have an effect on the consumption level. Summary statistics are reported in Table 1. In my empirical analysis I include only those individuals who have positive financial wealth, thus excluding the supposedly credit constrained agents. This restriction is satisfied for above 90% of the analyzed individuals in all the three datasets. Having positive financial wealth and being covered by private health insurance is positively correlated, the strongest correlation can be seen based on the HRS database.

- Income: The income is measured by the annual gross income, and as for the SHARE data this is ppp-adjusted. Out-of-pocket medical expenditures plus payments on health insurance contracts are treated as separate regressors in the estimations. I assume that medical expenditures are such exogenously determined costs that reduce the disposable income that can be spent on food consumption. However, since these expenditures might be larger than current income, subtracting them from the income measure could generate negative values, which would be problematic when logarithmic specification is used. Hence, I introduce it as an additional regressor in the estimation, and zero values are replaced with very small positive expenditure level, so as not to reduce the sample size when taking logarithm. The consumption is defined more widely in the ELSA and HRS (which includes spending on health as well), therefore for those databases there is no need to reduce the income measure by medical expenditures or by payments on health insurance.

- Bequests: In the estimations I control for intentions for leaving inheritance because of two reasons. First, there is some evidence in the literature that intended bequest can be an influencing factor of consumption level of older people, as also discussed e.g. by Hurd (1989). Second, the self-reported chances of leaving bequest can be correlated with voluntary health insurance coverage, if e.g. family background or risk aversion influence both, therefore its omission could bias the results.

  The proxy of bequest indicator is a variable on the 0-1 scale, generated the following way. It equals the self-reported chance of leaving inheritance above €50Th, £50Th, or $10Th in the SHARE, ELSA and HRS database respectively, if the answer for that question is non-zero. Otherwise it equals the chance of leaving any inheritance.

- Although in the theoretical model I assume that consumer preferences are the same, in the empirical analysis I control for some taste indicators, in order to improve the robustness of the results. These include gender dummy, children dummy (1 if the individual has children), age and education. The education level categories cannot be defined the same way for the three datasets, therefore only its sign can be interpreted. Higher values of this variable indicate higher level of education in all cases.

4 Linear regression results

4.1 OLS estimation

It is expected based on the life-cycle model that when controlling for wealth, income, bequest motives and life expectancy, being covered by voluntary health insurance increases the consumption level of individuals, since for them there is less need for precautionary savings. Because of likely nonlinearity, I use the logarithm of consumption, wealth and income in the estimation, hence the baseline model for individual i is:

$$\log(\text{consumption}_i) = \beta_0 + \beta_1 \text{insurance}_i + \beta_2 \text{life\_exp}_i + \beta_3 \text{beq}_i + \beta_4 \log(\text{wealth}_i) + \\ + \beta_5 \log(\text{income}_i) + \beta_6 \log(\text{med}_i) + u_i.$$

First, the model is estimated using only the SHARE database, and together for all the covered countries. The regression results for the baseline specification are reported in column (1) of Table 5. The results reported in Table 5 use all the five imputed datasets. However, using only the first imputations, the estimation results remain very similar.[16]

These results are basically in line with the consumption model of equation (4). The results show that having voluntary health insurance significantly increases the food consumption level, ceteris paribus (approximately by 21%). The other significant variables also have the expected effect, except for the subjective survival probability, which seem to increase the consumption level. This positive estimated effect can be partly due to endogeneity bias, but can also be the result of the effect of increased expected future income. Moreover, this can also be explained by changing preferences. As e.g. Jurges (2006) claims, better health (which implies higher life expectancy) might increase the marginal utility of consumption at the same time. Since the preferences are assumed to be constant and homogenous in my model, such potential effects are neglected. An additional problem in the estimation can be the sample selection - as I have described in Section 3, life-expectancy is missing non-randomly. The subjective bequeathing probabilities are insignificant.

	(1)	(2)	(3)	(4)
Insurance	0.207***	0.203***	0.082**	0.067*
Prob. survival	0.128***	0.114**	0.057	0.050
Prob. bequest	-0.036	-0.039	-0.045	-0.055*
log(Wealth)	0.025***	0.025***	0.030***	0.026***
log(Income)	0.108***	0.107***	0.119***	0.113***
log(Medical)	-0.017***	-0.017***	0.006	0.006
Age		-0.003	-0.004*	-0.003
Education				0.033***
Belg.			0.066	0.094*
Denm.			-0.331***	-0.334***
France			0.068	0.120**
Germ.			0.024	0.023
Greece			-0.069	-0.027
Italy			0.247***	0.294***
Netherl.			-0.224***	-0.199***
Spain			0.447***	0.497***
Sweden			-0.423***	-0.397***
Switz.			0.148	0.164*
const.	6.757***	7.005***	6.909***	6.889***
# obs.	2047			

Table 5: OLS estimation results, SHARE data; *,**,***: significant at 10, 5, 1 % significance levels respectively, based on Carlin's standard errors for multiple imputations

In the model up to now I have assumed that preferences are the same for all individuals. This cannot be

[16] In the next subsection, when results are compared with HRS and ELSA results, only one imputation will be used for the SHARE data as well.

a realistic assumption, therefore I have repeated the estimation with adding additional observables that can indicate consumer preferences. These variables are gender, children dummy, age, and education. From these controls neither has significant effect on consumption, but the p-value is the smallest for the age variable - the result of the estimation extended with the age variable is in column (2) of Table 5, which differs only slightly from the previous estimates.

In the next step, in order to account for some cross-country differences in consumption habits, I have estimated the model also with including country dummies, keeping Austria as the reference country. Controlling for the country of residence is important because country-specific characteristics, as cultural differences or institutions (like public spending on health care) influence not only the consumption decision but also the choice on voluntary insurance coverage. The results are in column (3) of Table 5. With this extension, the estimated coefficient of voluntary health insurance decreases, but remains significantly positive. The partial effects of survival probability and medical expenditures become insignificant. The other variables do not change considerably. Residency in two southern countries - Italy and Spain - has significant positive partial effect on the food expenditure level, whereas the same effect is significantly negative for Denmark, Sweden and the Netherlands. I return to further cross-country comparisons under Section 4.2.

Finally, I added again the above used additional preference controls to the regression - when country dummies are included, the education indicator (7-level ISCED codes) became significant and positive. The result extended with education variable is in column (4) of Table 5. When compared to the previous results, the partial effect of insurance coverage decreases, but remains significantly positive at the 10% significance level.

4.2 Cross-country comparison

4.2.1 Basic regressions

In Section 4.1 I have already pointed out that there are significant differences across countries not only in the rate of voluntary health insurance coverage, but also in the average spending on consumption. Since my interest is on the effect of voluntary health insurance coverage on consumption level, I analyze here whether there are cross-country differences in this effect as well. The differences can be explained with the heterogeneous institutional and cultural backgrounds. In this section I analyze these differences in more details. The estimation is extended to the U.K. (English Longitudinal Study of Aging, ELSA database) and the U.S. (Health and Retirement Study, HRS database). These can provide interesting additional comparisons. However, in order to keep the analysis tractable, I limit the continental European (SHARE) analysis to five countries: Belgium, France, Germany, the Netherlands, and Spain. My criterion in selecting these countries was to have the largest applicable sample size (based on the number of observations of single individuals aged at least 70, with no missing relevant variables). Italy and Sweden are also excluded from the following analyses, since less than five individuals are covered with voluntary private health insurance in the restricted sample. Since there is only one imputed value for the financial variables in the HRS and ELSA datasets, only one imputation is used also in the SHARE database. In the next subsection I use again all the five imputation, in order to increase robustness.

	Belg.	France	Germ.	Netherl.	Spain	U.K.	U.S.
Insurance	0.158**	-0.437***	0.301**	0.084	0.259	0.182*	0.163***
Prob. survival	0.022	0.011	-0.052	0.168	0.282*	-0.090	-0.011
Prob. bequest	-0.026	-0.110	0.052	-0.115	-0.101	0.193***	0.305***
log(Wealth)	0.034**	0.017	0.039*	0.031	0.020	-0.020	0.013
log(Income)	0.033	0.144***	0.211***	0.067	0.156***	0.836***	0.775***
log(Medical)	0.013	0.038*	-0.016	0.005	0.018**		
Age	0.011*	-0.006	-0.018***	-0.002	0.011*	0.004	0.020***
const.	6.529***	7.341*	7.178***	9.969***	5.868***	1.263**	0.459
# obs.	315	247	202	174	206	960	1225

Table 6: OLS estimation results for log consumption expenditure, cross country comparison; *,**,***: significant at 10, 5, 1 % significance levels respectively, based on robust standard errors

The estimation results are reported in Table 6. The partial effect of health insurance is generally positive under the OLS estimation, again supporting the theoretical expectations. This implies that the insurance coverage reduces the need for precautionary savings. The validity of the OLS results can be supported by the little variance in voluntary insurance coverage over time. Thus, it is unlikely that shocks affecting the consumption level would have an effect on the insurance coverage. However, the endogeneity problem due to some individual characteristics can still be a problem, which are discussed to some extent in Sections 4.2.2.

For six countries, the effect of subjective life expectancy on the logarithmic consumption level is close to zero and insignificant, the only exception is Spain, where this effect is significantly positive. This finding could be better analyzed with structural models, which leads to a separate line of research. The generally positive effect of the wealth and income measures is not surprising - higher wealth and income allow higher level of consumption expenditure. The estimated partial effect of income is larger for the U.K. and U.S. than for the continental European countries, however this result can be the consequence of the different definitions of the left hand side variables. Namely, food expenditure seems to be less sensitive to the income measure than the indicator of overall consumption expenditure. This observation points to one important weakness of the comparison, the difference in the response variable - this problem cannot be eliminated until only one wave of the SHARE is available. The self-reported chance of leaving bequest, and the medical expenditures in case of the SHARE data have no significant effect on the consumption level. In the U.K. and the U.S. the partial effect of bequest probability on the consumption is significantly positive, which is counter-intuitive. These positive, and large estimates indicate the limited applicability of the bequest proxy.

In this analysis the key variable of interest is the private (voluntary) health insurance dummy. Although there are differences in its definition across the three data sources, the estimation results are still comparable. It would be desirable to improve the validity of the results with finding suitable instruments for insurance coverage. However, without having long panels of observations, it seems that the available observables that have an effect on insurance coverage also influence the consumption decisions.

Turning to the estimates of Table 6, the negative coefficient on voluntary health insurance in case of France is not surprising. As also documented in Mossialos - Thomson (2004), the voluntary health insurance coverage in France is almost universal, it is for reimbursements of health care costs, and is provided free for those with low income. Therefore the insurance coverage in France cannot be regarded as an individual decision to reduce medical cost uncertainty.[17]

At the other extreme, the effect of health insurance on consumption level in case of Germany and Spain is relatively large - having voluntary life insurance increases the consumption level ceteris paribus on average by approx. 30% and 26%, respectively. However, this effect is insignificant in case of Spain. As for Germany, it is possible that this result is due to some regional effects. As Mossialos - Thomson (2004) point out, in Germany the average coverage was higher in the old states than in the new ones, in 1999. If in such areas the (food) consumption spending is generally higher, then this can lead to the observed results. Unfortunately, there are only very few observations in the SHARE database with non-missing indicator of the living area, so testing its effect is not possible. On the other hand, as a similar check it is possible for the U.S. to include region (census division) dummies in the regression, and it did not qualitatively change the results.[18] Moreover, there is some evidence that in Spain there is a regional concentration of coverage to urban areas, where more expenditure on food is expected, still the voluntary health insurance dummy there does not capture this regional effect, since its estimated coefficient is insignificant. The relatively high partial effect for U.K. is also surprising, because it is likely that the main motivation behind having voluntary health insurance is ensuring higher quality of health services, and avoiding waiting lists, not the reduction of possible future expenses. Without any further details it is not possible to find the reason behind this estimation result, however it would be worth for further investigations.

In the Netherlands the voluntary health insurance coverage has no significant effect on expenditure on food. This finding can be explained when the statistics presented in Table 3 are considered: the health insurance ensures only against two type of risks, namely dental care and drug expenses. This limited service

[17] In addition, France also differs from the other countries in that the education level has no significant effect on the voluntary health insurance coverage. This also points to the specific role of voluntary health insurance in France.

[18] There are remarkable differences across the U.S. census divisions in coverage. For example, based on the wave 7 data (year 2004), the insurance coverage of the analyzed elderly in the West North Central states was 66%, whereas that in the West South Central states was only around 40%. Still the average coverage in a state is a weak predictor of the individual insurance dummy, hence it cannot be used as an instrument for that.

might have little effect on precautionary savings. This finding also highlights that voluntary health insurance is not a homogenous service, its detailed terms might influence its effect on precautionary savings.

Apart from France, the estimated partial effect of health insurance coverage on consumption expenditures lies between $8-30\%$, and it is significant, except for Spain and the Netherlands. This suggests some evidence for those with private (voluntary) health insurance coverage afford themselves higher level of consumption, even when income and wealth are controlled for. Hence, these findings are in line with the theory of precautionary savings.

4.2.2 Some robustness checks

The estimation results presented under Table 6 are estimates of my baseline model. The included regressors correspond to the determinants of consumption if there is lifetime uncertainty, individuals might have bequest motives, and their preferences are the same. I have found that the partial effect of voluntary health insurance on consumption level varies across countries, but it is generally positive. Now I modify the specification of the empirical model in three steps, in order to analyze how sensitive are the results to the modelling assumptions. This is done only on the SHARE database, so as to ensure the same definition of consumption. Here all the five imputations are used, as described in Section 3 .

First, I omit the expected bequest and survival probabilities. These were not significant for any countries, and their omission can eliminate the potential selectivity problem stemming from non-response. Next, education level and children dummy are added as regressors. These variables are considered as such taste shifters that can influence consumption decisions and also the insurance coverage. Finally, the regressions are repeated with a narrower defined insurance category. Here the insurance dummy equals one if the individual has such insurance that finances dental care or provides a full coverage of costs for doctoral visits or costs for hospital care. These types of health insurance can clearly reduce the volatility of future health expenses (which is not necessarily true for such private health insurance types that offer extended choice of hospitals or doctors). These estimations are repeated for all those countries covered by SHARE where for both health insurance categories there are more than 10 individuals who are covered (this is not satisfied for Greece, Italy, Sweden and Switzerland).

The estimated coefficients of the voluntary health insurance dummy and the number of observations are reported in Table 7. Comparing the basic regression results (column 1) to the results presented in Table 6, using multiple imputations changes the estimated coefficient considerably only in case of Spain. The results reported in the first three columns are generally also similar, thus omitting subjective expectation indicators, and adding additional observables have only little influence on the estimated coefficient of voluntary health insurance. The exception is France, where the basic regression gives highly negative coefficient on insurance, which is mitigated with the modified specifications. In case of Spain the positive partial effect of insurance coverage remains insignificant but it increases. The change in the estimate for Spain is not surprising, since the subjective survival probability is significant there. If the narrower definition of health insurance is used (column 4), then its estimated partial effect on consumption is insignificant for all countries, and is negative for two countries, but these estimated coefficients are close to zero. Hence, if we use a more homogeneous definition for voluntary health insurance coverage, there remains only some weak evidence that it reduces the needs for precautionary savings. This effect varies across countries, being the highest in Spain and in Germany. The relatively low sample sizes make it also difficult to arrive at significant results. If the similar estimations as presented under column (4) are repeated jointly on the whole database, the estimated coefficient of the narrowly defined health insurance is positive but insignificant (0.018).

Apart from precautionary motives, an alternative explanation for the positive effect of health insurance on consumption of the old people in some countries could be that these people enjoy better health. For example, higher quality of medical care might be available for people having additional voluntary health insurance, thus leading to better health. Furthermore, healthier people might have higher consumption needs or eat out more often, thus spend more on food consumption. However, there is no evidence for this alternative direction of effects. When the self reported health is included in the last regression specification, it is insignificant in all cases, and the sign or significance of estimated effect of insurance coverage on consumption do not change for any country. Thus, this sensitivity analysis does not violate the presumed influence of precautionary saving motives.

A further evidence for the influencing mechanism of precautionary motives could be if voluntary health

	Basic regr.	Bequest, surv. prob. omitted	Edu, children dummy added	Narrower defined HI	# obs. in last regr.
Sp	0.151	0.206	0.202	0.213	280
Ge	0.308**	0.327**	0.268**	0.228	238
Au	-0.056	-0.044	-0.056	0.056	215
Dk	0.056	0.146	0.080	0.034	190
Nl	0.070	0.050	0.049	-0.035	237
Be	0.177**	0.171**	0.156**	0.033	424
Fra	-0.423**	-0.212*	-0.208*	-0.054	398

Table 7: Voluntary health insurance coefficient in OLS estimation for log consumption expenditure; *,**,***: significant at 10, 5, 1 % significance levels respectively, based on Carlin‘s standard errors for multiple imputations

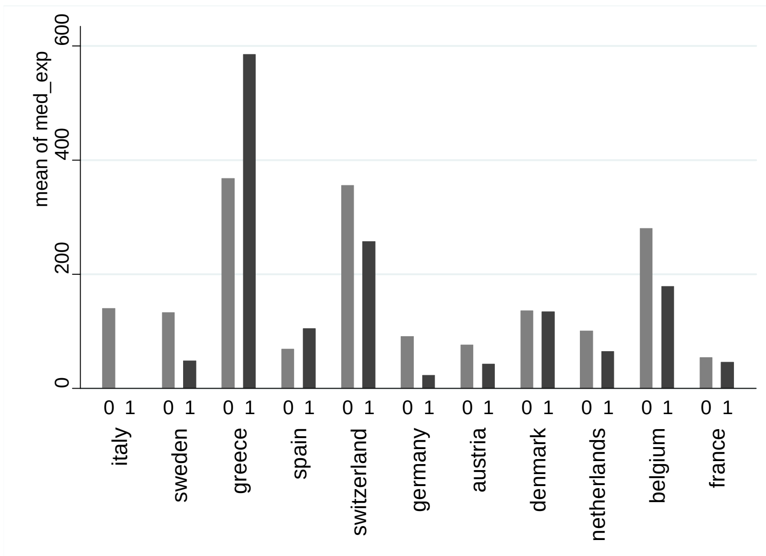

Figure 2: Ppp-adjusted mean of inpatient and outpatient care expenditure (singles, aged at least 70). 0/1: not covered/covered with narrowly defined private health insurance

insurance indeed reduced the out-of-pocket medical expenditures, thus allowing for higher expenditure on non-medical goods. However, average individual medical expenditure might also influence the decision on voluntary health insurance coverage. Moreover, Holly et al. (2005) and Paccagnella et al. (2005) claim based on SHARE data that in some countries additional health insurance coverage seems to create an incentive to spend more on health. They find it for broadly defined voluntary private health insurance coverage, and for overall out-of-pocket medical expenditures. In Figure 2 I instead show the average inpatient and outpatient care expenditure by country, and by coverage with the above defined narrower health insurance category (insurance that finances dental care or provides a full coverage of costs for doctoral visits or costs for hospital care). The countries are sorted according to the coverage rate (in line with Table 3). There is no clear relationship between the average medical expenses and the country average of coverage. On the other hand, except for Greece and Spain, this type of health insurance coverage seems to decrease, or at least not increase the out-of-pocket expenditure on inpatient and outpatient care.[19]

The interpretation of the estimated coefficients of health insurance and life expectancy variables in the consumption model can also be problematic due to potential endogeneity issues. Since older people still

[19]In case of Greece the relatively large average expenditure for those covered with such insurance is driven by only four observations.

have some option in having voluntary life insurance contracts, this can imply that the consumption level and the insurance dummy are simultaneously determined. For example, it could happen that increasing drug prices lead to contracting voluntary health insurance and decreasing consumption level at the same time. Since my analysis is limited to the oldest individuals for whom changing insurance status is not likely, this simultaneity is a minor problem. However, unobserved taste shifters can also cause endogeneity. In this case the estimation results cannot be interpreted as causal effect of voluntary health insurance coverage on consumption expenditure, but rather merely show average differences in these expenditures (holding the included observables fixed).

5 Further issues and conclusions

In this study I have shown that voluntary health insurance coverage generally has a positive partial effect on the consumption level of older people. This finding provides some evidence for the existence of precautionary saving motive, since additional health insurance coverage decreases the need for precautionary savings. Based on the SHARE data, the estimation could be repeated with a more homogeneous definition of private health insurance. With this specification the estimated effect of health insurance coverage on consumption remains positive but becomes weaker. These results cannot reflect the importance of different health care systems across countries. Repeating the estimations separately for some selected countries reveals the heterogeneous effect of voluntary health insurance on consumption level. Some further robustness checks have been presented, but the potential endogeneity of insurance coverage can weaken all the results. Extending the theoretical and empirical models to couples could further serve as a robustness check for the validity of the main results.

A further interesting issue not considered here is that even when controlling for wealth and income, higher subjective survival probability seems to have a positive effect on the probability of having voluntary health insurance, based on the SHARE database. It is not self-evident whether this finding is due to some reverse causality or maybe to some sort of self selection. In addition, the possibility of selectivity bias has to be mentioned again, since the life expectancy variable is not likely to be missing randomly - the potential consequences of this problem are also not clear yet. Furthermore, the potential consequences of measurement error in financial variables are also not considered in details in this analysis.

Finally, this analysis could be extended to arrive at policy implications. Basically through more detailed cross-country comparisons it would be possible to achieve some insights whether it could be desirable for governments to support voluntary health insurance coverage of elders. From this study I conclude that there is some weak evidence that voluntary private health insurance is welfare improving for the older people, since it decreases their future expenditure risks and allows higher consumption level, even when wealth, income, and the current insurance contributions are taken into account. However, this setup does not make it possible to analyze the overall welfare effects - contributions throughout the working life might have a negative effect on the lifetime utility. Moreover, voluntary health insurance coverage can lead to increased demand for health services. The complexity of this issue can be illustrated with the seminal study of Feldstein (1973), followed by Feldman - Dowd (1991), who claim that excess health insurance can have negative effects on welfare because of distorting the health care market.

In sum, this paper contributes to the understanding of expenditure decisions of older people, which can further be applied to policy issues related to the aging society. At this stage the emphasis has been put on modelling, methodological issues, and on the analysis of the first findings including international comparisons.

Appendix

A consumption model with mortality risk and uncertain medical expenditures

The maximization problem of individual i is:

$$\begin{aligned} &\max_{\{C_{it}, t=1...T_i\}} \sum_{t=1}^{T_i} s_{i1}^t (1+\rho)^{1-t} E_1\left(U(C_{it})\right) \\ &\text{s.t. } W_{it} = (1+r)(W_{it-1} - C_{it}) + Y_i - M_{it} \\ &\qquad W_{it-1} \geq C_{it}, \forall t = 1...T_i. \end{aligned} \tag{5}$$

C_{it} is consumption expenditure, Y_i is time-invariant income, W_{it} is wealth, M_{it} is out-of-pocket medical expenditure, s_{ij}^k is the subjective probability of individual i at time j of being alive at time k, ρ is the discount rate, and r is the interest rate. T_i is the maximum remaining years of life for individual i. $U(C_{it})$ is the utility function, assumed to be concave and increasing in C_{it}, and E_t is the expectations operator at the beginning of period t. Consumption happens at the beginning of each time period, whereas income and medical expenditure are realized at the end of each period, right after which the wealth level is determined. Death can happen at the turning points to new periods.

The constraints of problem (5) can be rewritten:

$$W_{i0} + Y_i \sum_{j=1}^{t} \frac{1}{(1+r)^j} - \sum_{j=1}^{t} \frac{M_{ij}}{(1+r)^j} \geq \sum_{j=1}^{t} \frac{C_{ij}}{(1+r)^{j-1}}, \forall t = 1...T_i. \tag{6}$$

The Bellman equation for the beginning of the tth period is:

$$V(W_{it-1}) = \max_{\{C_{it}\}} \left[U(C_{it}) + \frac{s_{it}^{t+1}}{1+\rho} E_t(V(W_{it})) \right], \tag{7}$$

and based on the constraints of (5) and (7), the Lagrangian is:

$$\Lambda_{it} = U(C_{it}) + \frac{s_{it}^{t+1}}{1+\rho} E_t \left[V((1+r)(W_{it-1} - C_{it}) + Y_i - M_{it}) + \lambda_{it}(W_{it-1} - C_{it}) \right]. \tag{8}$$

Hence the first-order conditions for optimality:

$$\begin{aligned} &\frac{\partial U(C_{it})}{\partial C_{it}} - \frac{s_{it}^{t+1}(1+r)}{1+\rho} E_t \left(\frac{\partial V(W_{it})}{\partial W_{it}} \right) - \lambda_{it} = 0 \\ &\qquad W_{it-1} - C_{it} \geq 0, \lambda_{it} \geq 0, \\ &\qquad \lambda_{it}(W_{it-1} - C_{it}) = 0. \end{aligned} \tag{9}$$

Denoting the optimal consumption path of individual i with $C_{it}^*, t = 1...T$, from (7):

$$V(W_{it-1}) = U(C_{it}^*) + \frac{s_{it}^{t+1}}{1+\rho} E_t \left[V((1+r)(W_{it-1} - C_{it}^*) + Y_i - M_{it}) \right]. \tag{10}$$

Differentiating it with respect to W_{it-1} gives:

$$\frac{\partial V(W_{it-1})}{\partial W_{it-1}} = \left[\frac{\partial U(C_{it}^*)}{\partial C_{it}^*} - \frac{s_{it}^{t+1}(1+r)}{1+\rho} E_t \left(\frac{\partial V(W_{it})}{\partial W_{it}} \right) \right] \frac{\partial C_{it}^*}{\partial W_{it-1}} + \frac{s_{it}^{t+1}(1+r)}{1+\rho} E_t \left(\frac{\partial V(W_{it})}{\partial W_{it}} \right). \tag{11}$$

Substituting the first condition under (9) into (11):

$$\frac{\partial V(W_{it-1})}{\partial W_{it-1}} = \lambda_{it} \frac{\partial C_{it}^*}{\partial W_{it-1}} + \frac{s_{it}^{t+1}(1+r)}{1+\rho} E_t \left(\frac{\partial V(W_{it})}{\partial W_{it}} \right). \tag{12}$$

If the credit constraint is binding, then $\lambda_{it}\frac{\partial C^*_{it}}{\partial W_{it}} = \lambda_{it}\cdot 1 = \lambda_{it}$, otherwise $\lambda_{it}\frac{\partial C^*_{it}}{\partial W_{it}} = 0\cdot\frac{\partial C^*_{it}}{\partial W_{it}} = \lambda_{it}$. Therefore from (12) and (9):

$$\frac{\partial V(W_{it-1})}{\partial W_{it-1}} = \lambda_{it} + \frac{s_{it}^{t+1}(1+r)}{1+\rho}E_t\left(\frac{\partial V(W_{it})}{\partial W_{it}}\right) = \frac{\partial U(C_{it})}{\partial C_{it}}. \tag{13}$$

Rewriting (13) gives the modified Euler equation:

$$\frac{\partial U(C_{it})}{\partial C_{it}} = \frac{s_{it}^{t+1}(1+r)}{1+\rho}E_t\left(\frac{\partial U(C_{it+1})}{\partial C_{it+1}}\right) + \lambda_{it}. \tag{14}$$

Assume that the utility of current consumption is of the constant relative risk aversion (CRRA) form: $U(C_{it}) = \frac{C_{it}^{1-\gamma}}{1-\gamma}$. γ is the coefficient of relative risk aversion, and its reciprocal $\varphi(=\frac{1}{\gamma})$ is the intertemporal elasticity of substitution. Using this assumption, the Euler equation (14) can be rewritten:

$$C_{it}^{-\gamma} = \frac{s_{it}^{t+1}(1+r)}{1+\rho}E_t\left(C_{it+1}^{-\gamma}\right) + \lambda_{it}, \tag{15}$$

and after rearrangement, provided that the credit constraint is not binding:

$$\frac{s_{it}^{t+1}(1+r)}{1+\rho}E_t\left[\left(\frac{C_{it+1}}{C_{it}}\right)^{-\gamma}\right] = 1. \tag{16}$$

The additional uncertainty due to the medical expenses makes it impossible to directly derive an expression for the consumption level, based on the Euler equation. Therefore, I follow the procedure described in details by Carroll (2001) for second-order approximations. The starting point is identifying a random variable η_{t+1}, for which $\frac{C_{it+1}}{C_{it}} = 1+\eta_{it+1}$. Based on the second-order Taylor series expansion of $(1+\eta_{it+1})^{-\gamma}$ around $\eta_{t+1}=0$: $\left(\frac{C_{it+1}}{C_{it}}\right)^{-\gamma} = (1+\eta_{it+1})^{-\gamma} \approx 1-\gamma\eta_{it+1}+\frac{\gamma(\gamma+1)}{2}\eta_{it+1}^2$. Substituting this expression into equation (16) gives:

$$\frac{s_{it}^{t+1}(1+r)}{1+\rho}E_t\left(1-\gamma\eta_{it+1}+\frac{\gamma(\gamma+1)}{2}\eta_{it+1}^2\right) \approx 1. \tag{17}$$

Using that for small η_{it+1}, $\Delta\log C_{it+1} = \log(1+\eta_{it+1}) \approx \eta_{it+1}$, from equation (17):

$$\frac{s_{it}^{t+1}(1+r)}{1+\rho}\left[1-\gamma E_t\left(\Delta\log C_{it+1}\right)+\frac{\gamma(\gamma+1)}{2}E_t\left(\eta_{it+1}^2\right)\right] \approx 1. \tag{18}$$

Taking logarithm, and using that $\log\left[1-\gamma E_t\left(\Delta\log C_{it+1}\right)+\frac{\gamma(\gamma+1)}{2}E_t\left(\eta_{it+1}^2\right)\right] \approx -\gamma E_t\left(\Delta\log C_{it+1}\right) + \frac{\gamma(\gamma+1)}{2}E_t\left(\eta_{it+1}^2\right)$ gives:

$$\log s_{it}^{t+1} + \log(1+r) - \log(1+\rho) - \gamma E_t\left(\Delta\log C_{it+1}\right) + \frac{\gamma(\gamma+1)}{2}E_t\left(\eta_{it+1}^2\right) \approx 0, \tag{19}$$

and after rearrangement:

$$E_t\left(\Delta\log C_{it+1}\right) \approx \frac{\log s_{it}^{t+1} + \log(1+r) - \log(1+\rho)}{\gamma} + \frac{\gamma+1}{2}E_t\left(\eta_{it+1}^2\right). \tag{20}$$

If it is assumed that the expected change in consumption is relatively small (which is satisfied e.g. if $r\approx\rho$ and $s_{it}^{t+1}\approx 1$), then the variance of η_{it+1} (σ_i^2) can be used instead of its second moment. In addition, as in Carroll (2001), the expectation error is defined as $\epsilon_{it+1} = \Delta\log C_{it+1} - E_t\left(\Delta\log C_{it+1}\right)$, therefore equation (20) can be rewritten as:

$$\Delta\log C_{it+1} \approx \frac{\log s_{it}^{t+1} + \log(1+r) - \log(1+\rho)}{\gamma} + \frac{\gamma+1}{2}\sigma_i^2 + \epsilon_{t+1}. \tag{21}$$

This expression highlights the importance of including the uncertainty term in the Euler equation. If that is correlated with the subjective survival probability s_{it}^{t+1}, which is likely to be the case, then omitting σ_i^2 from the Euler equation (21) would lead to biased estimates. Keeping in mind that the results are approximate, taking the exponential of equation (21) and setting the expectation error to zero gives the following (not exact) expression for the optimal consumption change (with $\varphi = \frac{1}{\gamma}$):

$$\frac{C_{it+1}}{C_{it}} = \left[\frac{s_{it}^{t+1}(1+r)}{1+\rho}\right]^{\varphi} \cdot \left[\exp(\sigma_i^2)\right]^{\frac{\gamma+1}{2}}. \tag{22}$$

Denoting $V_i = \exp(\sigma_i^2)$, and using that $s_{i1}^2 \cdot s_{i2}^3 \cdot \ldots \cdot s_{it}^{t+1} = s_{i1}^{t+1}$, iteration of (22) gives:

$$C_{it+1} = C_{i1}\left[\frac{s_{i1}^{t+1}(1+r)^t}{(1+\rho)^t}\right]^{\varphi} V_i^{t\frac{\gamma+1}{2}}. \tag{23}$$

I assume that the expected present value of bequest equals its targeted value B_i, if the consumption path follows the path determined under (23). The expected present value of bequest equals $\sum_{j=1}^{T_i}(s_{i1}^j - s_{i1}^{j+1})(W_{i0} + Y_i \sum_{l=1}^{j}\frac{1}{(1+r)^l} - \sum_{l=1}^{j}\frac{E_1(M_{il})}{(1+r)^l} - \sum_{l=1}^{j} C_{il}\frac{1}{(1+r)^{l-1}})$, and equation (23) can be substituted for C_{it}, which gives:

$$W_{i0} - B_i + Y_i \sum_{j=1}^{T_i} s_{i1}^j \frac{1}{(1+r)^j} - \sum_{j=1}^{T_i}\frac{E_1(M_{ij})}{(1+r)^j} = C_{i1}\sum_{j=1}^{T_i} s_{i1}^j \frac{1}{(1+r)^{j-1}} \cdot \left[\frac{s_{i1}^j(1+r)^{j-1}}{(1+\rho)^{j-1}}\right]^{\varphi} V_i^{(j-1)\frac{\gamma+1}{2}}, \tag{24}$$

and after rearrangement:

$$C_{i1} = \frac{W_{i0} - B_i + Y_i \sum_{j=1}^{T_i} s_{i1}^j \frac{1}{(1+r)^j} - \sum_{j=1}^{T_i}\frac{E_1(M_{ij})}{(1+r)^j}}{\sum_{j=1}^{T_i} s_{i1}^j \frac{1}{(1+r)^{j-1}} \cdot \left[\frac{s_{i1}^j(1+r)^{j-1}}{(1+\rho)^{j-1}}\right]^{\varphi} V_i^{(j-1)\frac{\gamma+1}{2}}}. \tag{25}$$

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